REMARKS

Patented claims 1-23 and reissue claims 24-37 are present. Claims 24-37 stand rejected. Claims 2,12,13,23 or the patented claims and claims 26,33,36,37 of the reissue claims are amended herein to correct typographical errors and for clarity. Reconsideration is kindly requested.

Applicant hereby affirmatively states that no assignee exists.

Amendments to the patent are provided above. Several of these amendments correct typographical errors (e.g., missing punctuation, mis-spellings, plural v. singular, etc.). Some of these errors were generated by the PTO, some by Applicant. Amendments are also made to the descriptions of Figs. 1 and 2 so that the text more accurately reflect what is shown in the figures. The amendments tend to be of the type that could be cured with a Certificate of Correction, but are included instead in this reissue so that all issues may be considered in one course of action. Marked-up versions of the replacement paragraphs and claims as required by 37 CFR §§1.121(b) and (c) are respectively provided.

Recapture

Claims 24-37 were rejected under 35 U.S.C. §251 as being an improper recapture of broadened claim subject matter surrendered in prosecution of the patent upon which the present reissue is based. Applicant respectfully traverses this rejection.

The application as originally filed taught an acoustic wave device that included **a transmit component** and **a receive component**. The claims in the patent as originally issued recited a system (or method) that includes **both** the transmit component and the receive component. The newly submitted claims (24-37) recite the **transmit component** and the **receive component** separately. Although the transmit and receive components were clearly disclosed in the specification, separate claims to these components were not previously submitted. See independent claims 1,9,19 and 25 as filed (and independent claim 26, added by amendment) and follow these claims through their prosecution. Each claim includes a reference to both transmit and receive components. Thus, Applicant is not trying to recapture subject matter previously surrendered. To the contrary, Applicant is

trying to claim subject matter that was disclosed in the specification, but not previously claimed. This is proper under 35 U.S.C. §251 because the application is still owned by the original independent inventor and the reissue application was filed within two years from the grant of the original patent.

Limitations of Reissue and Patented Claims

The patentable subject matter of the newly submitted transmit and receive based claims is derived from the patented system claims. An essential aspect of the present invention is combining or mixing a row and a column signal at each transucer to achieve an appropriate control signal for each transducer, whether the device is operating in transmit or receive mode. This basic "theme" is present in the patented system claims and the separate transmit and receive claims submitted in the reissue application.

Claim 24 (transmit component) recites:

1. "a plurality of electro-acoustic transducer elements ...;"

2. "control circuit for propagating row and column control signals ...;" and

3. achieving "... a **mixing at each transducer element of the row and column control signal** for that transducer element in such a manner as to provide a **focused, acoustic signal** at a given focal distance and direction from said array."

This can be compared, for example, with patented independent claim 16 which recites:

1. "an array of electro-acoustic transducer elements ...;"

2. "control means ... for generating row control signals ... and column control signals ...;" and

3. "a plurality of **active devices** ... for **combining** the row control signal and the column control signal of that transducer element ..." .

Combining with an active device and is a manner of **mixing.**

With respect to independent claim 29, this claim includes limitations similar to those of claim 24 and further includes the limitation of each transducer element functioning "in a non-linear

manner in operation." Patented claim 19 recites "a non-linear electro-acoustic material."

With respect to independent claim 30 (receive component), this claim recites:

1. "a plurality of electro-acoustic transducer elements …;"

2. "control circuit for propagating row and column control signals …;" and

3. achieving "… a **mixing at each transducer element of the row and column control signal** for that transducer element **with a resultant electrical signal** corresponding to an acoustic signal incident on that transducer element; and"

4. achieving "… **focused acoustic signal reception** at a given distance and direction from said array."

Mixing to achieve a **focused acoustic signal** is a manner of "coherently combining" signals as recited in patented independent claim 22, amongst others (e.g., patented independent claim 1 recites forming "a coherently combined array output signal …".

Limitations of the dependent claims 25-28 and 31-37 are also found in the patented claims. While Applicant would be pleased to indicate supportive or analogous language for each of the dependent claims should the Examiner so desire, for brevity Applicant now presents a representative few. Claim 27 language is found in patented claim 1, line 12. Claim 32 language is found in patented claim 19. Claim 36 language is found in patented claim 22 and others.

Accordingly, Applicant submits that the reissue claims do contain some of the limitations of the patented claims.

Prior Art

Claims 24-26 and 29 are rejected under 35 USC §102 as being anticipated by Breimesser.

Breimesser does not disclose or suggest "a mixing at each transducer element of row and column control signal for that transducer element." Breimesser uses an electronic pulsing scheme and individually communicates to each transducer element (not through a mixing or combining of row and column control signals). Col. 3, lines 18-20, recite

"In the transmit mode, the control device 20 transmits transmit pulses for the transducer elements E_{ij} with individually specified starting times t_{ij}. ..."

It should also be recognized that Breimesser is apparently not available as prior art under §102. It was published Jan 19, 1995, which is less than one year before the filing of the present application.

Accordingly, Applicant respectfully submits that Breimesser does not anticipate cláims 24-26 and 29.

Claims 27-28 and 30-37 are rejected under 35 USC §103 as being unpatentable over Breimesser in view of Lederman. Claims 27 and 28 are patentable due to their dependency from claim 24 discussed above and further in view of their own limitations. For example, claim 28 recites a chirp which is not disclosed or suggested by the combination.

Claim 30 recites **mixing of row and column control signals at each transducer** in the receive component or embodiment. Breimesser does not provide mixing but rather demultiplexer based electronic selection of output signals from specific transducer elements (see Col. 4, line 60, to Col. 5, line 5). Lederman also fails to disclose or suggest this limitation.

Lederman does teach the use of coded signals, but only improve signal to noise ratio. Since Breimesser and Lederman fail to disclose or suggest, either individually or in combination, the row and column control signal based mixing as claimed in claim 30, claim 30 and its dependents are not render obvious by these references.

Dependent claims 31-37 are allowable due to their dependency from claim 30 and their individual limitations. Claim 31, for example, recites dynamic focusing, claim 35 recites a chirp, claim 36 recites phase and frequency shifting for coherent combination, and claim 37 recites fewer control channels than transducer elements. Applicant thus submits that claims 27-28 and 31-37 are allowable over Breimesser and Lederman.

In view of the foregoing Amendments and these Remarks, Applicant respectfully submits errors in the specification are cured and that Claims 1-23 (the patented claims) and claims 24-37 (the reissue claims) are now in condition for allowance. Early notification of

same is respectfully requested. Should the Examiner believe that a telephone conference would help further the prosecution of this case, the Examiner is requested to contact the undersigned at the listed telephone number.

The Assistant Commissioner is hereby authorized to charge underpayment of any fees (including any filing fees under 37 C.F.R. §1.16 for additional claims and any patent application processing fees under 37 C.F.R. §1.17 including any fee for extension of time) associated with this communication or credit any overpayment to Deposit Account No. 01-0272. A duplicate copy of this authorization is enclosed.

Respectfully Submitted
on behalf of Applicant,

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Separate, marked-up version of amended paragraphs (§1.121(b)):

In the Specification:

Replace the paragraph at Col. 1, lines 9-23, with the following:

Conventional acoustic wave imaging systems use a one dimensional (1-D) array of electro-acoustic transducers, for example, a 1 X 100 array, and have been configured to achieve linear, curved linear and sector scanning. Coherence in the transmission and receipt of acoustic signals is achieved by the utilization of delay devices in the signal processing channels. Present one dimensional systems are disadvantageous due to (1) the manner in which they are constructed and (2) inherent limitations in their scanning capabilities. With respect to the manner in which they are constructed, one disadvantage is that the use of delay elements[,] and related electronics adds considerably to the cost of one dimensional systems. With respect to inherent limitations, one dimensional scanning systems are disadvantageous in that they only provide two dimensional images.

Insert the following paragraph at Col. 2, line 19:

It is also an object of the present invention to transmit and/or receive acoustic energy with these 1-D or 2-D acoustic arrays.

Replace the paragraph at Col. 2, lines 19-21, with the following:

These and related [objective] objectives of the present invention are achieved by use of the acoustic wave imaging system and method described herein.

Replace the paragraph at Col. 2, lines 41-49, with the following:

In one embodiment, the present invention comprises a plurality of electro-acoustic [transducer] transducers, each capable of generating an electrical signal indicative of an incident acoustic wave; means in communication with each [transducers] transducer for generating a coded signal for transmission by each of said transducers; and means in communication with each of said transducers

for modifying a coded signal received by the transducers to achieve a desired delay.

Replace the paragraph at Col. 2-3, lines 62-4, respectively, with the following:

And in yet another of many embodiments, the present invention includes an array of electro-acoustic transducers having a plurality of rows and columns; a plurality of row control lines, each of which is coupled to the transducers in one of said plurality of rows; a plurality of column controls lines, each of which is coupled to the transducers in one of said plurality of columns; and control means coupled to each of said plurality of row and column control lines for generating a control signal for each [transducers] transducer that is a combination of control signals on the row and column control lines for that transducer.

Replace the paragraph at Col. 4, lines 13-34, with the following:

Referring to FIG. 1, a perspective view of an acoustic wave imaging system 10 in accordance with the present invention is shown. The system 10 includes interface circuit 20 which is connected via line 85 to operator interface componentry represented by reference numeral 80 and via line 75 to a display mechanism 70. Both the operator interface componentry 80 and the display mechanism 70 are known in the art and are discussed in more detail below with reference to FIG. 3. The interface circuit 20 is also connected, via line 22, to a row control circuit 30 and, via line 28, to a column control circuit 40. The row and column control circuits 30,40 control the phase and frequency of signals propagated to a plurality [a] of M rows and N columns in an array 100 of acoustic transducer elements. Each transducer element [comprises a acoustic transducer] (cells 110,[120,]140,170,180,190 are indicated in FIG. 1) [and its] includes a corresponding transducer (shown in FIG. 2). The row control signals are propagated over M row control lines or processing channels, represented generally by arrow 35, and the column control signals are propagated over N column control lines or processing channels, represented generally by arrow 45.

Replace the paragraph at Col. 5, lines 46-58, with the following:

FIG. 2 illustrates 9 transducer cells 110 [(not labelled in FIG. 2 due to crowding in the figure, but labelled in FIG. 1)], 120,130,140,150,160,170,180,190 and their corresponding acoustic transducers 115,125,135,145,155,165,175,185,195. In the composite implementation, each transducer is mounted to its corresponding cell in the same manner that transducers are connected to semiconductor substrates in IR focal plane arrays or the like. The dotted lines are provided to indicate that the number of cells is variable and may be modified in either dimension. Cell 150 is surrounded by a dashed line and will be described as a representative cell.

Replace the paragraph at Col. 5, lines 46-58, with the following:

The row control circuit 30 consists of a plurality of individual row signal generating circuits 231. A first of these [in] is connected via line 251 to the first mixer of cells 110,120,130. Similarly, a second and a last row signal generating circuit 231 are connected via lines 252 and 253 to cells 140,150,160 and cells 170,180,190, respectively. The column control circuit 40 consists of a plurality of individual column signal generating circuits 241. A first of these [in] is connected via line 261 to the first mixer of cells 110,140,170. A second and a last column signal generating circuit 241 are connected via lines 262 and 263 to cells 120,150,180 and cells 130,160,190, respectively.

Replace the paragraph at Col. 7, lines 5-13, with the following:

Referring to FIG. 4, a frequency versus time diagram is shown for a linear FM chirp. Chirps as a characterized electrical signal and matched filters therefor are generally known. Though an up chirp is shown it should be recognized that since the attenuation of sound is strongly dependent on frequency, a down chirp may also be used and may be more appropriate in some instances. Furthermore, it may also be appropriate to transmit high frequencies at a higher voltage level.

Replace the paragraph at Col. 9, lines 8-22, with the following:

FIG. 2 shows several cells and transducers of the active 2-D array 100. Here each array element is connected to the output of its own electronic mixing circuit. One input of [the] each mixer is connected to an electrode that is shared by all other array elements on a given row. Likewise, the other input is connected to the corresponding column electrode. Mixing the external row and column signals together produces two signal components at each array element, one that is the sum of the frequency and phase of the row signal and column signal, and the other which is the difference. By choosing the frequency of the row and column signals such that only the difference (or sum) frequency is within the pass-band of the transducer ensures that only the difference (or sum) frequency (and phase) component will be radiated from the array.

Replace the paragraph at Col. 9, lines 40-46, with the following:

Together with array 100, control signal generators 30,40 comprise the beamforming process of system 10. The frequency and phase of the row and column array control signals determine the focus and angle of the transmit and receive beams in accordance with the equations herein. Having generally introduced transmit and receive operations, broadband applications [is] <u>are</u> now discussed.

Separate, marked-up version of amended claims (§1.121(c)):

In the Patented Claims:

2 (amended). The apparatus of claim 1, wherein said coded signal is a chirp.

Claim 12, line 1, after "comprising:" begin a new paragraph.

13 (amended). The apparatus of claim 12, wherein said array has a plurality of rows and a plurality of columns each having one of said plurality of control channels associated therewith;

said control signal generating means further including means for generating row and column control signal components; and

wherein each transducer element is uniquely and simultaneously controlled by a combination of the row and column control signal components for that transducer element.

23 (amended). An acoustic imaging apparatus, comprising:

control logic;

a plurality of transducer elements arranged in an array, each coupled to said control logic and capable of transmitting an acoustic signal representative of an electrical transmit control signal propagated from said control logic and generating an electrical receive signal representative of an incident acoustic signal;

means within said control logic for generating an electrical transmit control signal for each transducer element that contains a frequency based coded signal and [cause] causing each transducer to emit an acoustic signal representative of said coded signal;

means for modifying the frequency and [chase] phase of an electrical receive signal of each transducer element for coherently combining reflected coded signals within the electrical receive signals thereof;

means coupled to said modifying means for decoding the combined reflected coded signals to achieve a time delay base on that coded signal; and

means coupled to said decoding means for generating image data from an output signal therefrom.

In the Reissue Claims:

26 (amended). The apparatus of claim 24, wherein said control circuit includes a control channel for each of said M rows and a control channel for each of said N columns, and wherein the number of control channels is fewer than the number [to] of transducer elements.

33 (amended). The apparatus of claim 30, wherein said filter [is] includes a matched filter.

36 (amended). The apparatus of claim 30, wherein the transducer elements and the control circuit are configured such that the row and column control signals for each transducer element [contains a] contain an appropriate frequency and phase shift that, when combined with the electric signal corresponding to an incident acoustic signal at that transducer element, modifies the received electric signal in such a manner as to permit the coherent combination of the modified received electric [signal] signals from all of said plurality of transducer elements.

37 (amended). The apparatus of claim 30, wherein said control circuit includes a control channel for each of said M rows and a control channel for each of said N columns, and wherein the number of control channels is fewer than the number [to] of transducer elements.